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RECORD OF REVISIONS

Rev	Date	Description	POC	OIC
0	2/9/04	Initial issue. Collected/expanded on topics in other ESM chapters; added new topics (backfit, D&D, specs); App A (SD)	Tobin Oruch, <i>FWO-DO</i>	Gurinder Grewal, <i>FWO-DO</i>
1	6/9/04	Refined designer, temporary definitions; added code of record documentation; revised "conflict;" revised constants; added MEL population; clarified output submittals and programmatic applicability; added various spec requirements, Buy American Act guidance.	Tobin Oruch, <i>FWO-DO</i>	Gurinder Grewal, <i>FWO-DO</i>
2	In prog	<i>Clarified sealing of design</i>		

PLEASE CONTACT THE RESPONSIBLE ESM POC AND COMMITTEE
 for upkeep, interpretation, and variance issues

Section Z10	General POC/Committee
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LANL Eng Standards including this one: <http://www.lanl.gov/f6stds/pubf6stds/xternhome.html>

Z1010 ADMINISTRATION (PROGRAMMATIC & FACILITY)

Where appropriate, guidance is provided to aid in the implementation of requirements. Guidance will be *italicized* text or otherwise clearly indicated. All other text in regular type indicates mandatory requirements unless prefaced with wording identifying it as guidance or a recommendation.

1.0 ACRONYMS AND DEFINITIONS

Acronym	Definition
AHJ	Authority having jurisdiction
consider	<p>When used in a guidance (e.g., italicized) statement, it is suggesting the designer look at and think about following the guidance offered.</p> <p>When “consider” is used in a requirement statement it strongly indicates that LANL does not want the suggestion dismissed out of hand. Good practice is to document the thought process of this consideration, particularly when rejecting the suggestion partially or wholly. In some cases in the ESM, documentation is specifically required (e.g., design notes or memo to file); in other cases, submittal of such documentation for approval is required.</p>
Constructor	The entity performing fabrication or physical construction activity at LANL.
Contractor	The entity performing the work, including one or more of the following: design, offsite fabrication, or onsite construction or maintenance. This may be the SSS, another contractor, or a LANL M&O employee. Term used in specifications and elsewhere.
CSI format Specifications	The numbering and 3-part format defined by the Construction Specifications Institute’s MasterFormat and SectionFormat documents (see LCSM below).
Design agency	The LANL organization or subcontractor (A/E) responsible for the preparation of engineering design and documentation [from LIR220-03-01]
Design authority	<p>The individual appointed by the responsible division leader or program manager to be responsible for the acceptability of engineering work for a given Division, Program, or project. This individual shall be responsible for the acceptability of all laws, DOE Orders, national codes and standards chosen -- and applicable ES requirements -- to the engineering activities in their functional area of responsibility.</p> <p>Guidance Note: Per LIR 280-02-01, Institutional Facility Management, FWO is responsible for "ensuring that the Laboratory real property and installed equipment is compliant with applicable codes and standards;" therefore, FWO is responsible for establishing the applicable codes and standards for real property projects. [from LIR220-03-01]</p>
designer	Anyone working in a design agency capacity, whether engineer, architect, drafter, or designer.
ESM	LANL’s Engineering Standards Manual (OST220-03-01-ESM)

Acronym	Definition
Facility	A synonym for Real Property and Installed Equipment. RP&IE is the land, improvements on the land such as buildings, roads, fences, bridges, and utility systems and the equipment installed as part of the basic building construction that is essential to normal functioning of a building space, such as plumbing, electrical and mechanical systems. This property/equipment is also referred to as institutional or plant and was formerly known as Class A. [DOE Order 4330.4B]
ITS	Important to safety (here, those defense-in-depth SSCs that are not SC or SS).
LCSM	LANL Construction Specifications Manual (OST220-03-01-CSM). These CSI numbered/formatted specifications address construction-type work and maintenance (two examples: piping repairs and testing, carpet and other like-for-like replacements).
M&O	Management & Operating, as in the prime contractor running LANL (e.g., UC)
ML	management level, defined in LIR 230-01-02, Graded Approach for Facility Work (or Programmatic equivalent). <i>Guidance: Related LIG.</i>
nonreactor nuclear facility	Those facilities, activities, or operations that involve, or will involve, radioactive and/or fissionable materials in such form and quantity that a nuclear or nuclear explosive hazard potentially exists to the workers, the public (all individuals outside the DOE site boundary), or the environment, but does not include accelerators and their operations and does not include activities involving only incidental use and generation of radioactive materials or radiation such as check and calibration sources, use of radioactive sources in research and experimental and analytical laboratory activities, electron microscopes, and X-ray machines. ¹
POC	Point-of-Contact
Programmatic	A synonym for Personal Property and Programmatic Equipment. PP&PE is equipment used purely for programmatic purposes, such as reactors, accelerator machinery, chemical processing lines, lasers, computers, machine tools, etc., and the support equipment dedicated to the programmatic purpose. This property/equipment is also referred to as organizational, research, production, operating or process and was formerly known as Class B. [DOE Order 4330.4B]
Project	Any activity involving the installation, modification, or permanent removal of an SSC at LANL. Includes related fabrication, construction, procurement, and maintenance activities.
Safety Class (SC) SSC	A nuclear facility term, <i>Safety class structures, systems, and components</i> means the structures, systems, or components, including portions of process systems, whose preventive or mitigative function is necessary to limit radioactive hazardous material exposure to the public, as determined from safety analyses. [10 CFR 830: § 830.3 Definitions.]
Safety-related	See Safety SCC below
Safety SSC	A term meaning safety class, safety significant, and safety-impacting ML-1 and ML-2 SSCs; any of these could potentially impact worker or public safety or the environment if they failed.

¹ DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*.

Acronym	Definition
Safety Significant (SS)	Structures, systems, and components not designated as safety-class SSCs but whose preventive or mitigative function is a major contributor to defense in depth (i.e., prevention of uncontrolled material releases) and/or worker safety as determined from safety analyses. [10 CFR 830: § 830.3 Definitions, except parenthetical note.] As a general rule of thumb, safety-significant SSC designations based on worker safety are limited to those SSCs whose failure is estimated to result in an acute worker fatality or serious injuries to workers. Serious injuries, as used in this definition, require medical treatment for immediately life-threatening or permanently disabling injuries (e.g., loss of eye, loss of limb) from other than standard industrial hazards. It specifically excludes potential latent effects (e.g., potential carcinogenic effects of radiological exposure or uptake). [DOE-STD-3009 Chg. 1]
SSC	Structure, system, or component
SSS	LANL's Support Services Subcontractor (KSL at time of writing)
temporary (and permanent)	See Section Z1030 below.
WSS	Work Smart Standards, a set of contractual documents on Environmental Health and Safety. Currently contained in Appendix G of the University of California/DOE Contract. http://labs.ucop.edu/internet/comix/

2.0 BACKFIT (DESIGN ADEQUACY) OF NUCLEAR/HAZARDOUS SSCs

- A. When an existing structure, system, or component (SSC) is upgraded to safety class, ML-1, safety significant, ML-2, or important-to-safety (ITS), the Design Authority organization (*typically the system engineer or their management*) shall initiate a formal backfit analysis. The analysis process shall determine if the SSC complies with the current standards or, if not, establish the feasibility and cost effectiveness of modifying the SSC to comply with current standards. The documented analysis shall include independent verification/signature and final acceptance by the Design Authority.
1. If the process finds that the field configuration complies with current standards, then the analysis shall be submitted to the Design Authority for review and approval.
 2. If modification is found to be necessary, feasible, and cost effective, then design activities shall be performed utilizing the current standards.
 3. If modification is found to be either not feasible or not cost effective, then the system's responsible division, in conjunction with the Design Authority and safety basis organization (*e.g., PS-4*), shall submit for a variance to the ESM requirements in accordance with [LIR 301-00-02](#), Variances and Exceptions to Laboratory Operations Requirements.

- B. Include as a part of the backfit analysis an evaluation of the need to upgrade non-safety SSCs that may interface or interact with the newly-upgraded safety SSC. If a non-safety SSC prevents a safety SSC from performing its safety function, then isolation devices, barriers or upgrades shall be provided (DOE-G-420.1, Section 5.1.2.2).
- C. Consider following the Savannah River Site backfit procedure and/or the EFCOG white paper on design adequacy; *both are available from either the FWO Chief Engineer or Engineering Standards Manager.*

3.0 CODES AND STANDARDS

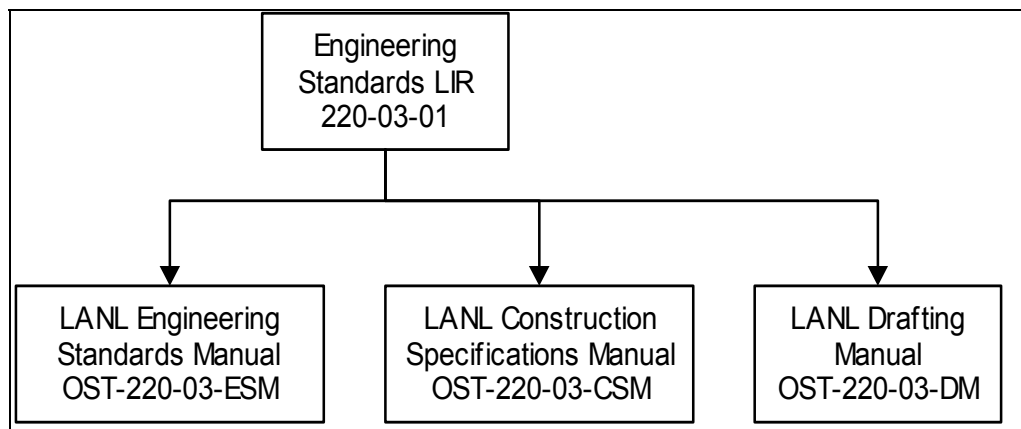
- A. Comply with the applicable portions of the latest edition and addenda of each code, standard, and DOE Order invoked by the ESM and LANL contract (*typically in Appendix G and the Work Smart Standards [WSS] listing*) unless the ESM indicates a particular edition (referring here to actual ESM requirements, not citations of codes in footnotes, endnotes, or other commentary).
- B. If the ESM specifies a later edition than the WSS, follow the ESM unless doing so is less conservative. WSS: <http://labs.ucop.edu/internet/comix/>

A sample of the WSS listings of general interest are:

- *International Building Code, latest edition, with exceptions per ESM*
 - **Note:** In all places where the IBC refers to the *ICC Electrical Code* substitute the *National Electrical Code*[®]. In all places where the IBC refers to the *International Fire Code* substitute the *NFPA National Fire Codes*. Buildings and structures designed and constructed to fully meet the requirements of NFPA-101, Life Safety Code, shall be considered to have met the “life safety” requirements of OSHA, 29 CFR 1910, IBC, IBC and all other codes²
- *NFPA codes and standards (except NFPA 5000; NEC edition as noted)*
- *[DOE Order 420.1A, Facility Safety](#) (with exceptions noted in WSS)*
- *[DOE O 6430.1A, General Design Criteria, Division 13](#), Special Facilities, (so long as it remains in the Work Smart Standards; has requirements for nuclear and explosives facilities). **Note:** Where 6430.1A Div 13 references requirements in other divisions, those requirements are also mandatory.*
- C. Follow all applicable Codes of Federal Regulation (CFRs), latest edition. *These are federal agency requirements that have the force of law. Rules, Orders and Laws can be found at: http://www.lanl.gov/f6stds/pubf6stds/engrman/HTML/Universe_links.htm*

² Basis: [LIR 402-900-01, LANL Fire Protection Program](#) (§6.1.4; WSS), also J. Streit memo, (EMRef 24.)
(**Note:** EMref refers to a Standards Program internal filing system for hard-to-find references.)

- D. For national and DOE standards, in general, if a standard is required, then its “shall” statements must be followed if applicable – but “should” statements need not be followed to be in conformance with the standard. If, however, the ESM or LCSM mandates non-mandatory sections of national/DOE-type standards, then those sections become required for LANL work.
- E. **Online Codes and Standards:** Access to selected online national codes and standards are available to anyone with a LANL IP address or “smart card” at:
<http://lib-www.lanl.gov/infores/stand/stanihs.htm>



3.1 LANL Engineering Standards

A. Engineering Standards Manual (ESM), OST 220-03-01-ESM

Guidance: This chapter's section number (Z10) follows the UNIFORMAT system promulgated by the Construction Specifications Institute (CSI), described in ASTM E1557, and summarized in ESM Chapter 12, Nuclear (App A).

1. Comply with standard detail drawings in the ESM unless referenced in italicized text. Edit the details to reflect the particular details of the project, but do not delete applicable requirements without ESM Discipline POC approval. Only delete portions that in no way apply.

B. LANL Construction Specifications Manual (LCSM), OST220-03-01-CSM

1. See Subsection on Specifications later in this Section Z10.
2. Programmatic: LCSM sections required for Programmatic work are those referenced in ESM sections designated for programmatic.

C. LANL Drafting Manual, OST220-03-01-DM (becoming – LDM)

1. Comply with the LANL Drafting Manual when creating or revising drawings for facility projects. *Guidance: This manual does not address weapons design work covered by ESA Division procedures. Use of the LANL Drafting Manual is recommended for programmatic work.*

The above manuals are available at: <http://www.lanl.gov/f6stds/pubf6stds/xternhome.html>

4.0 CODE OF RECORD

- A. Code of Record: The codes and standards in effect when design is completed are considered the “codes of record” and often remain in effect for the life of the constructed project. Establishment and maintenance of a facility’s design basis during design and construction, including “codes of record” shall be in accordance with LIR 240-01-01, Facility Configuration Management, and requirements in the ESM (including documentation required by the Structural, Hazardous and Nuclear Chapters and others). *Guidance: The design basis includes the design inputs such as design criteria and codes, plus design decisions captured in studies and calculations. Also see the “Renovations/Upgrades” Subsection in this document.*
- B. Underway: Projects are generally not required to comply with new or revised LANL Engineering Standards issued after the project commences (i.e., “underway”). The definition of underway and additional discussion is contained in [LIR 220-03-01, Engineering Standards](#).
 - 1. *Guidance: It is often to a project’s or contractor’s advantage to voluntarily adopt newer standards during design. Newer LANL standards incorporate local and national lessons learned for safety, cost effectiveness, new products and overseer expectations. Newer specs have updated product information and logistical information for working at LANL. In both cases, these can improve the design, construction, start-up, and operation phases.*
- C. Code of Record Documentation: Projects shall document and maintain the specific edition of the codes and standards used as their basis in a project record document once they have reached the “underway” point (including LANL ESM and specs, DOE Standards, and national and state codes and standards). [Guidance: Producing a CD-ROM of the LANL Standards can accomplish that portion of the whole and greatly aid design reviewers.]
- D. *Guidance: Requests for Proposal (“bid documents”) should state the key design basis codes such as Building Code of Record (e.g., IBC-2003) and Life Safety Code of Record (e.g., NFPA 101-2000).*
 - 1. *Guidance: At time of writing LANL Supply Chain Management Division contract provisions specify that the required standards for that contract are those in effect on the date of the solicitation unless the Request for Proposal specifically invokes a different set. See quotation on Contracts under Conflicts section below.*

5.0 “CONFLICTS” AND ADEQUACY

- A. “Conflicts”: The most stringent requirement among all ESM chapters and codes and standards invoked by the ESM shall be followed, even when they might be conflicting. The exception is where a chapter recognizes a conflict and directs how to proceed (e.g., *A chapter may direct use of NFPA Life Safety Code egress provisions in lieu of those in the building code*). Refer questions concerning “conflicts” in the Engineering Standards manuals to the applicable LANL discipline POC. The FWO Chief Engineer has authority to resolve general

- and multi-discipline issues, and has delegated discipline-specific authority to the ESM Discipline POCs.
- B. “Guidance Conflicts”: Similarly, having a requirement in one place and a guidance statement in another place that is similar or addressing the same issue is not a conflict and the requirement shall be followed (*this is often intentional – practicing technique of having directive in one/best place and referring to it or reiterating it elsewhere; e.g., reference to WSS in 2.0.A “guidance” above*).
- C. Specs “Conflicts”: If the ESM and LCSM conflict, the ESM has precedence and the project-specific spec shall be made to complement the ESM by the designer.
- D. Codes and Standards: If a requirement in any LANL document exceeds a minimum code or standard requirement, it is not considered a conflict, but a difference, so comply with the most stringent requirements among the LANL documents.
- E. Contracts: *Guidance: At time of writing, LANL contracts for design-build projects (and presumably other construction contracts) stated the following in Article 4, Interpretation and Intent:*
1. *Order of Precedence: Any inconsistency in the requirements for performing this Contract shall be resolved by giving precedence in the following order:*
 - a. *this agreement and all written modifications hereto;*
 - b. *any written Technical Guidance or amendments furnished by the University Contract Administrator;*
 - c. *the Specifications;*
 - d. *the General Provisions; and*
 - e. *the Contractor’s proposal.*
 2. *Incorporation by Reference. Unless otherwise specifically provided, the current revision of each publication, standard, or other authority incorporated by reference in the Specifications shall govern. “Current revision” means that revision in effect on the date of the solicitation. In the event of a conflict between any documents incorporated in this Contract by reference and any express provision of this Contract, the Contract shall govern.*
 3. *Omissions; Mis-Descriptions. The Contractor shall not be relieved of performing the details of any work manifestly or customarily performed to carry out the intent of this Contract. All work shall be performed as if fully and correctly set forth and described in the Contract....*
- F. Incorrect Standards: The adequacy of all design inputs is the responsibility of the designer/design agency. If the designer believes the LANL Standards (a design input) to be incorrect (e.g., compliance will cause a problem), it is their responsibility to bring the issue to the attention of the applicable ESM Discipline POC (via the LANL Project Manager if appropriate) for resolution.

- G. Complete Design: The engineer/designer is responsible for a complete, coordinated design package (e.g., drawings or sketches, specifications, etc.) as required to meet project specific requirements. Refer questions concerning the contents in the Engineering Standards manuals to the applicable LANL discipline POC. *Guidance: The manuals are not intended to cover all design requirements and construction specifications necessary to provide a complete operating facility or system.* The design organization is responsible to provide a complete design package, including all necessary specifications.

6.0 “CONSTANTS”

Following are “constants” to be used for most design at LANL. These are generally adequate and conservative; however, when other ESM chapters contain other constant values, they take precedence. Also, there may be instances where these or other ESM “constants” are not conservative; then, designer shall use conservative or actual values.

- A. Altitude: 7500 feet
- B. Latitude: 35.9 deg N, Longitude 106.3 deg W (TA-6 weather station)
- C. Barometric Pressure (avg): 11.10 psia (22.65 inches Hg).¹
- D. Air Density (7,500 feet): I-P: 0.057 pounds/cubic foot (0.075 pcf at standard air)³
 - S-I: 0.00091 g/cm³ (0.0012 at standard air/sea level)
- E. Air Density Ratio: $0.075/0.057 = 1.32$ (Reciprocal = 0.76)

Note: Exceptions to the above (where altitude and the other data must be corrected):

1. For mechanical and electrical design for TA-16 use 7780 feet; at TA-57 Fenton Hill site use 8600 feet (both approximate actual elevations). For lower Pajarito Road and other lower areas use actual elevation when required for adequate design margin.⁴
2. Design “clean” fire extinguishing agents using a design altitude no higher than actual per ESM Chapter 2 and LCSM Section 13967 to ensure conservatism.

7.0 DEACTIVATION, DECOMMISSIONING, AND DEMOLITION (D&D)

- A. When designing new systems and facilities, consider how D&D might be performed and design to facilitate it where practical (*additional requirements for hazardous systems appear in ESM Chapter 10*).

The remaining paragraphs refer to the actual D&D process:

³ FWO Calculation No. 00-00-CALC-M-0003.

⁴ *Basis: Altitude at LANL ranges from 6250 ft at TA-39 to 7780 ft at TA-16. Info from USGS 1:24000 quadrant maps: Frijoles, NM and White Rock, NM. Altitude affects design and operation of many mechanical, electrical, and other components; this effect is addressed in more detail in those ESM chapters.*

- B. As a minimum, perform D&D to a plan that describes the scope of work, work boundaries, utility de-energizations and locations, and protection of non-scope SSCs.
- C. As appropriate, further describe D&D work using drawings or sketches. *Guidance: Use clouding or other methods as described by the LANL Drafting Manual. The addition of photos in the drawings is a common and helpful technique for helping to describe the work.*
- D. Obtain FWO-DECS or other appropriate LANL engineering group review of D&D plans prior to work initiation.
- E. For electrical demolition refer to ESM Chapter 7 and LCSM Section 16095, Electrical Demolition.

8.0 DESIGN OUTPUT SUBMITTALS

8.1 Project Files -- General

- A. Document design by a set of calculations and drawings and design/evaluation criteria that demonstrate the design is both safe and cost effective. The project file shall include information important to the accomplishment of the design. *This should include significant written correspondence, summary of significant telephone calls, design and design-evaluation criteria whether furnished by LANL or designer-generated, working notes, and calculations.* When the design is complete, there shall be a historical record showing how the design progressed and reasons for changes.

8.2 Calculations

- A. Prepare design calculations to document analytical determinations. Calculations shall be checked, reviewed, signed, and dated by the designer and the checker, complete in all respects and shall reflect the basis for selection of systems and components.
- B. Submit calculations to LANL design authority for review and approval. This approval does not relieve the designer of any responsibility for correctness and coordination with the drawings and specifications.
- C. The calculations will become record calculations for LANL and may be used in the future for modifications. Room numbers, equipment nomenclature, fixture numbers, zone numbers, or any other designations shall be consistent with those indicated on the drawings or in the specifications.
- D. These calculations will eventually be microfilmed or electronically scanned if electronic copies are not available. For this reason, calculations shall be printed clearly and with sufficient darkness to assure clarity if reproduction or scanning from the microfilm is necessary. Index calculations in a logical order and include adequate sketches to allow an engineer to follow and comprehend them easily.

- E. Note references (source) for unusual formulas or methods of analysis, including edition of the reference and page number. Include explanation of the method used in computer (or calculator) programs, playback of input data, and clear formats for computer-generated information. Clearly identify numbers in formulas as to the units involved; i.e., psi, gpm, etc. List all assumptions and exceptions, and define all units. Provide copies of tabulated data used. If a computer program was used, provide input file on CD.
- F. Computers: Use the following procedures to perform design calculations with computers:
- Use computer programs approved for use by the LANL Design Authority (ESM Discipline POC for facilities).
 - Present complete documentation of new programs used.
 - Present this information in fundamental language such that an engineer unfamiliar with the program can understand the functions, limitations, and method of analysis used.
 - Provide sufficient documentation to enable the verification of the method of data input and the interpretation of the output calculations.
 - Submit plans, flow diagrams, sketches, etc., to completely illustrate the source of input data in such fashion that another engineer can easily check the input data for accuracy.
 - Present a complete computer listing of input and output data (CD acceptable).
 - Neatly arrange sketches, input, output, and other material pertinent to the analysis and commit to 8 1/2 x 11 inch sheets, where practical, and include in the complete analysis presentation. Submit the information for review per LANL Project Management established procedures.
 - Software shall be controlled with a graded approach consistent with LANL LIR 308-00-05, Software Quality Management
http://labreq.lanl.gov/pdfs/ops/01_operations/lir3080005.pdf
Guidance is contained in companion LIG 308-00-05
http://labreq.lanl.gov/pdfs/ops/01_operations/lig3080005.pdf
- G. *Guidance: LANL procedures that may be useful to designers who do not have formal calculation procedures meeting above requirements:*
- [*FWO-DO-603, Calculations*](#) (to be superseded by [*IFMP AP-ENG-007*](#) in the future)
 - [*PMD-0304, Drawings, Specifications, Design Calculations and Documents*](#)

8.3 Drawings and Other Outputs

- A. Drawing content and format shall comply with the LANL Drafting Manual.

- B. Sealing (Stamping): Comply with the New Mexico Engineering and Surveying Practice Act (Chapter 61, Article 23 NMSA 1978 <http://www.state.nm.us/pepsboard/act.html>) codified in the NM Administrative Code under Title 16, Chapter 39 (esp 16.39.3.12). http://www.nmcpr.state.nm.us/nmac/_title16/t16c039.htm All drawings, specifications, ECNs, DCPs, calculations, and reports prepared by consultants or contractors that are involved in the practice of engineering shall bear the seal (stamp) and signature of a professional engineer (PE), currently licensed in New Mexico, in responsible charge and directly responsible for the engineering work. For the purposes of the Act, a licensee of the NM Board 'has "responsible charge of the work" as defined in Section 61-23-3, paragraph K, and may sign, date and seal/stamp plans, specifications, drawings or reports which the licensee did not personally prepare when plans, specifications, drawings or reports have been sealed only by another licensed engineer, and the licensee and/or persons directly under his personal supervision have reviewed the plans, specifications, drawings or reports and have made tests, calculations or changes in the work as necessary to determine that the work has been completed in a proper and professional manner. (16.39.3.12.E) ⁵
1. PEs shall only seal those discipline drawings for which they are in responsible charge and directly responsible for the engineering work, none for which they are not.
 2. Design-Build: Documents shall be sealed before construction begins. Exceptions: Site preparation and excavation can proceed. Project Managers may authorize construction-start prior to sealing at risk and with FWO Chief Engineer approval.⁶
 2. Architectural: Follow the requirement above except that such documents shall bear the seal of a NM-registered architect per the NM Architectural Act based on Article 15 of Ch 61. http://www.nmbea.org/Law/law_frames.htm
 3. Exceptions: Fire detection/alarm system and sprinkler design/shop drawings prepared by factory-qualified, NICET Level-III-certified fire alarm contractors need not be sealed ([National Institute for Certification in Engineering Technologies](#)). *If they are to be sealed and a fire protection engineer is not involved, a mechanical engineer could conceivably stamp a fire suppression drawing, as could an electrical stamp a fire detection and alarm drawing, in the rare case such individuals have sufficient demonstrated knowledge, experience, and expertise in this specialized design area.*
 4. UC-employed engineers, performing engineering services involving the operation of LANL, on LANL property, are exempt from the licensing requirements of the New Mexico Engineering and Surveying Practice Act.⁷ ~~Direct-report (job shop) contractors to LANL are also considered exempt based on historical practice; task-order contractors are not.~~

⁵ The WSS requires that LANL follow New Mexico Regulations: "Requirements of applicable federal, state, and local laws and regulations that address environment, safety, and health." The New Mexico Engineering and Surveying Practice Act, paragraphs 61-23-3.E, 61-23-21, and 61-23-22 define the practice of engineering and establish qualification and performance requirements for registered professional engineers as a matter of public safety.

⁶ Basis: Helps ensure safety of construction workers, limits LANL liability with safety and unacceptable work.

⁷ Memo from Lab Counsel to Tobin Oruch, 7/19/01 (EMref-3). *Direct-report (job shop) contractors to LANL are also considered exempt based on NMSA 1978 61-23-22; task-order contractors are not.*

5. SSS employees shall follow the Acts and this section, and seal design.⁸

6. *Guidance: Sealing as-built drawings is not required.*⁹

8.4 Design/Evaluation Criteria

A. Documentation shall include, but is not limited to, the following:

1. Design basis documents as required by change control procedures (e.g., ECN, DCP) or other ESM chapters (e.g., *Structural Chapter's DBD document, documents required by Hazardous and Nuclear Chapters*). *These are recommended for all projects*
2. Equipment Selection Criteria: Include flow rates, pressure or head requirements, operating temperatures, efficiency, energy consumption, and sound ratings. If manufacturer selection program is used, verify that altitude correction for motor size is properly performed.
3. Include copies of catalog sheets showing equipment performance points for all major equipment included in the systems design.

9.0 ENVIRONMENTAL QUALIFICATION¹⁰

A. The requirements identified within this section are for safety SSCs or those systems that provide a mission critical, defense in depth, or worker safety function or whose failure may impact the operation of safety SSCs. For other non-safety systems, this section shall be

⁸ Basis: Letter, Othmer to Forrester, 11/17/03. (EMref-15)

⁹ Memo from T. Oruch to M. Koop dated 3/14/02 (EMref-4) and [ESM Interpretation No. 2002-02, Rev. 0](#).

¹⁰ The requirements identified within the Environmental Considerations section are "Good Engineering Practice" and must be established for Safety-related systems to ensure that the environment in which the systems will be placed is conducive to the performance attributes of the selected components. DOE G 420.1-1, Section 5.1.1.3, establishes the requirement for environmental qualification as deemed necessary to ensure reliable performance of a safety system under those conditions and events for which it is intended.

The requirements and guidance within the section are developed through several standards. ASME AG-1, "Code on Nuclear Air and Gas Treatment," Article IA-4000 – Design Considerations, requires the identification of environmental conditions for safety-related systems. Additional requirements and guidance were developed through several standards that identify environmental conditions that could adversely impact the operability of the most sensitive (e.g., I&C) equipment. These standards establish methods to recognize and classify such environmental conditions. The standards are as follows:

- ISA-71.01, "Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity"
- ISA-71.02, "Environmental Conditions for Process Measurement and Control Systems: Power"
- ISA-71.03, "Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences"
- ISA-71.04, "Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants"
- IEEE 1-2000, "Recommended Practice – General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation"
- IEEE-1159, "Recommended practice for Monitoring Electric Power Quality"
- IEEE-1100, "Recommended Practice for Powering and Grounding Electronic Equipment IEEE Emerald Book."

interpreted as guidance that establishes sound engineering practice for the proper and reliable performance of such SSCs.

9.1 General

- A. The environmental conditions in which SSCs must operate or which can affect the proper or continued operation of SSCs shall be clearly identified and considered in design and equipment selection. Normal ambient, abnormal operating, climatic, and event conditions shall be evaluated in the identification of applicable environmental conditions.

The environmental factors that shall be considered when selecting SSC location or SSCs for a location include, but are not limited to, the following:

- temperature and/or humidity extremes
- barometric pressure variations
- airflow
- corrosive atmospheres
- area flooding
- acoustic noise
- electronic noise, or electromagnetic interference (EMI)
- power supply quality (electrical surges, frequency variations, etc.)
- grounding
- lighting
- lightning protection
- physical security
- vibration
- interference from large motors and power feeders
- chemical and particulate (dust) contamination
- radiation
- elevation above sea level
- seismic considerations including proximity to earthquake faults

10.0 EQUIPMENT LOCATION

- A. Maintenance: Mechanical, electrical, controls, and similar equipment shall be accessible for inspection, service, repair, and replacement without removing permanent construction, as required by code and as recommended by the manufacturer. Locate equipment in a non-rad, unsecured area (when possible) to facilitate maintenance.¹¹
1. If safety-related (SC, SS, important-to-safety, hazardous process related) equipment is not accessible with a man-lift or rolling platform, then provide permanent OSHA compliant structures for access to equipment installed 12 feet or higher above finished floors (e.g., HVAC and controls).¹² *Guidance: This requirement should be considered*

¹¹ [LIR/LIG 402-100-01](#), Signs, Labels, and Tags; and 1997 IAPMO UPC, Section 601.2.

¹² 1997 IAPMO UMC, Section 305. Also, DOE-HDBK-1140, "Human Factors / Ergonomics Handbook for the Design for Ease of Maintenance," Section 4.9.3.6, identifies a maximum usage height of 12 feet for a painter's type stepladder. For Safety-Related systems this represents the minimum height for ease of surveillance and maintainability given the potential apparatus available for the performance activities.

not only for safety-related equipment but for any component that is located 12 feet or higher, especially if frequent access is necessary.

- B. Outside: Select sites carefully when locating equipment on grade. Ensure that factors such as snow accumulation and drift, ice, windy areas, rainwater from roof overhangs, etc., do not affect equipment performance and maintenance. *Avoid locations on the north side of the building.*
- C. Noise: Locate equipment to minimize noise and sound vibration transmission to occupied areas of the building and adjacent occupied areas/structures.
- D. Roofs: Locate equipment a minimum of 10 feet from the edge of roof or inside face of parapet. If the distance is less than 10 feet, specify a 42-inch-high restraint, e.g., guard rails, parapet, screen wall, etc.¹³
- E. Security: Consider protecting critical equipment from attack (e.g., gunfire and explosives).

11.0 MASTER EQUIPMENT LIST (MEL)

- A. Projects shall develop MEL data to include, as a minimum, all safety SSCs and all other facility SSCs requiring maintenance or surveillance (additional SSCs may be required by LIR 240-01-01, Facility Configuration Management) as a turnover document prior to close-out of the project. When not entered directly into the MEL, a spreadsheet that can be uploaded to the Computerized Maintenance Management System (CMMS) MEL shall be used. Unless otherwise stated in the Contract Documents, the Constructor is responsible for populating all required fields of a spreadsheet, saving it as a CSV (comma delimited) file type, and submitting to the LANL Project Manager for subsequent system engineer review, approval, and incorporation into the MEL. The spreadsheet format to be used is controlled by FWO Procedure IFMP AP-MNT-010. The format will be made available to designers upon request (internal link: http://fwo.lanl.gov/fwo_pub/fwo_ibs/frp/html/ap_doc_index.htm#MNT).

12.0 PROGRAMMATIC APPLICABILITY

- A. The ESM shall be applied to programmatic SSCs as follows:
 - 1. Headings in ESM chapter sections followed by “Programmatic and Facility” or a bold capital “P” or “P&F” indicate that subsection shall be complied with by all of LANL, including programs (*this document’s subsection heading “Z1010” is an example*).
 - 2. Furthermore, programmatic structures, systems, and components (SSCs) performing the same function as facility equipment shall be considered “facility” from the standpoint of being required to follow the entire LANL Engineering Standards (i.e., follow everything in the ESM, LCSM, and Drafting Manual. Examples include buildings, transportables, HVAC equipment, electrical equipment, etc.). Standards Discipline POCs are the Authorities Having Jurisdiction (AHJ) for judgments on this (appeals to the FWO Chief Engineer (and, if necessary, FWO Division Leader).

¹³ 29 CFR 1926.501(b)(1) requires fall protection when the working distance from the equipment is 6 feet or less; 10 feet minimum distance allows for equipment door swings and removal of equipment. .

- a. *Many basic facility SSC functions are defined by ESM Chapter 1 Section 210, System Lists (see Table 210-3 for common systems).*

13.0 RENOVATIONS/UPGRADES/ALTERATIONS/REPAIRS

- A. Bring existing structures, systems, and subsystems into compliance with current codes and requirements in the ESM when renovation or other upgrade work includes major replacements, modifications, or rehabilitation that exceeds 50% of the estimated replacement value¹⁴ of the existing structure, system or subsystem.¹⁵ Consider upgrading whenever safety is an issue.
 1. This requirement applies on a system or subsystem basis (e.g., an HVAC system or train of one, a structure, an electrical distribution system, etc.).
 2. Systems and subsystems are listed in Section 210 of Chapter 1 of the ESM.
 3. The most-affected-discipline POC is the authority having jurisdiction for determinations on this requirement. The POC/AHJ has the authority to require upgrade of any or all of a system to current code on a case-by-case basis (regardless of percentage) when safety is a concern.
 4. Modifications, replacements, and rehabilitation projects shall comply with current codes and the LANL ESM. Under certain circumstances when allowed by the Design Authority and the applicable ESM POC, the “codes of record” can be applied to later modifications, replacements, or rehabilitation projects involving less than 50% of the estimated replacement value when justifiable.

14.0 SIGNS, LABELS, AND TAGS

- A. Identify SSCs in accordance with the nomenclature indicated in LANL Engineering Standards Manual, [Chapter 1](#), Section 230, Component Nomenclature.
- B. Label SSCs in accordance with LANL Construction Specification [15075](#), Mechanical Identification; LANL Construction Specification 16075, Electrical Identification; and ESM Chapter 1, Section 240, Labeling (future).
- C. Building/structure signage (including wayfinding signage) is addressed in ESM Chapter 4, Architectural (Section B-C_GEN).
- D. *Guidance: Additional information on labeling may be found in the LANL Conduct of Operations LIR (part addressing chapter 18 of the ConOps order (future)).*

¹⁴ Replacement value determined using recognized cost estimating procedures and a national material and labor cost database.

¹⁵ This is necessary to assure that significant renovations are more than just skin deep. Over time this requirement will bring about safety, functionality, and efficiency upgrades to the underlying SSCs. This percentage was accepted by the TRB per Minutes from the Facility Engineering Manual Technical Review Board meeting on 7/19/00. Fifty percent is also used in the 2001 Santa Fe County Urban Wildland Interface Code for use of fire resistant materials in renovations and for the total luminaire replacement requirement in ASHRAE/IESNA 90.1-2001, Section 4.1.2.2.5. Fifty percent of total square footage is also used for Level 3 alterations per Chapter 3 of the International Existing Building Code which was adopted by New Mexico effective July 1, 2004.

- E. For other signs refer to [Signs, Labels, and Tag LIR402-100-01](#), associated [LIG 402-100-01](#), [Signs, Labels, and Tags](#), and the online “[Sign Catalog](#).”
- F. *Labeling: In addition:*
- *Mechanical equipment labeling is described in ESM Mechanical Chapter 6 Section D10-30GEN.*
 - *Electrical equipment labeling is described in ESM Electrical Chapter 7 Section D5000.*
 - *Chemical container labeling is described by [Chemical Management LIR 402-51-01](#).*

15.0 SPECIFICATIONS

- A. When a LANL Construction Specifications Manual (LCSM) section (“spec”) applicable to the work at or for LANL exists, its requirements shall be followed regardless of who performs the work or the authorizing or contractual methods used to initiate the work.
- B. When editing the LCSM specification templates to suit the project, add job-specific requirements and delete only those portions that in no way apply.
- D. To seek a variance from applicable LCSM requirements, contact the ES discipline POC.
- E. A CSI-format spec package (book of sections) adequately describing the work shall be prepared by the Design Agency and followed by the Contractor whenever any of the following criteria are met:
1. The work is ML-1 or ML-2.
 2. The estimated construction cost is \$300k or more.

Note: Both the Chapter 1 and ESM POC of the most-affected discipline can grant variance to the above.

Guidance: A CSI spec package is recommended for all other projects, and especially when multi-discipline or complex. Very basic projects may be able to capture needed instructions elsewhere (in ECN or DCP instructions, sketches, or drawings). Specifications are preferred over extensive drawing notes.

- F. Specification packages (“books”) shall comply with LCSM general requirements (e.g., Section 200) including Table of Contents, approval sheet, format, language, and tailoring of spec to match project requirements (including deletion of unneeded subsections and paragraphs). Books and single sections shall also have footers with project ID, section number and “X of Y” page numbering. *Guidance: Technical spec sections should be bundled together with the Division 1 general requirements sections (e.g., Submittal Procedures, Product Options & Substitutions, and Project Record Documents, etc.)*

- G. Number the specification sections in accordance with the CSI MasterFormat document. The minor numbering differences between the major commercial spec services are allowed (i.e., MasterSpec, SpecText, BSI). The designer shall correct LCSM sections to properly reference other LANL sections used -- and designer-added sections. *Guidance: Once LANL adopts the CSI MasterFormat planned for publication in 2004 (MF04) numbering scheme (as evidenced by over one-half of the LCSM sections being renumbered to 6-digit MF04 section numbers on the LANL website), the designer should number all spec sections used (and internal cross-references) per MF04 for clarity and continuity.*
- H. Buy American Act: Comply with this Act ([41 U.S.C. 10a - 10d](#)) and Executive Order 10582, December 17, 1954. *Guidance: When LANL is the purchaser of goods, the key provision of LANL policy is that American products should be specified except when it is not likely that the lowest acceptable offer for a domestic end product or construction material will exceed the lowest acceptable offer for a foreign end product or foreign construction material, inclusive of duty, by more than 6% if the domestic offer is from a large business, or more than 12% if the domestic offer is from a small business concern.*¹⁶
- I. ML-1/ML-2: Draft changes from LCSM master spec sections for ML-1/ML-2 SSCs shall be produced using Word Track Changes (*deletions should be ~~Strikethrough~~ and additions be **bold** text with a right border line*).
1. Electronic review drafts shall be made available to LANL reviewers upon request.
 2. Hardcopy drafts and finals shall have all tracking removed (changes accepted; plain, clean text).
- J. ML-1/ML-2: Warning: Many LCSM specs were not written for ML-1/ML-2 projects and did not receive independent review before issuance. This is being stated in those specs as they are being revised; however, some do not include this warning as yet. ML-1/ML-2 projects shall ensure that their final specs contain adequate QA requirements and have received independent technical review by a qualified reviewer. *Guidance: Typical additions for ML-1/2 specs: qualifications of designers and installers, more detailed construction submittals, more rigorous material receipt and control, and more rigorous field quality control. Good examples of ML-1/2 specs are LCSM Sections 11608, 11610, and 11620 on gloveboxes.*

16.0 VARIANCES

- A. Personnel shall not deviate from the LANL Standards in developing the RFP (including F&OR and other programming documents and performance criteria), in design, or in written direction to the Contractor, unless the Standards Program has formally granted such variance to the project (per Engineering Standards LIR 220-03-01).

¹⁶ UC Procurement Standard Practices (SP) 25.1 Buy American Act and Balance of Payment Program 4/24/02
http://labs.ucop.edu/sp-labs/lanl/t_2501.pdf

- B. Requested variances and exceptions to the ESM text (not standard details/drawings) requirements shall be per [LIR 301-00-02](#), Variances and Exceptions to Laboratory Operations Requirements and [LIR 220-03-01](#), Engineering Standards, and ESM Chapter 1 Section 100. [At time of writing, this required submission to the applicable POC for initial review and approval prior to the POC forwarding to the Standards Manager, FWO Chief Engineer, and FWO Division Leader].
1. Per Chapter 1 Section 100:
 - a. *Variance to standard details, the Drafting Manual, and the LANL Construction Specifications Manual only require the Discipline POC's approval.*
 - b. *NCR: Variances and exceptions are intended for future work. When work has proceeded contrary to the Engineering Standards and submitted for LANL acceptance, a nonconformance report (NCR) shall be used to disposition the situation. [Project Management Div Procedure 0313, Nonconformance Reporting](#), can be used when more appropriate procedures/forms do not exist. Submit NCR to the applicable POC for disposition concurrence prior to the POC forwarding to the Standards Manager, Chief Engineer, and FWO Division Leader for information (appeal process is same entities in sequence).*
 - c. *WSS: Variance from DOE contractual requirements (e.g., Work Smart Standards) requires DOE/NNSA approval in addition to requirements above.*
 - C. Variances shall be clearly indicated as such and brought to the attention of the applicable Standards POC for resolution (review, acceptance, or lack of rejection of design or other submittals not meeting the Engineering Standards or Contract shall not constitute a variance to the Standards – nor tacit approval to continue with non-acceptable work).
 - D. When specifically allowed by ESM sections, the graded/tailored application of codes and standards is not considered a variance to the ESM. When the graded approach is used to define the appropriate methodology for code and standard application, that methodology and rationale shall be formally documented and become part of the project design documents. The applicable LANL Engineering Standards POC is the authority having jurisdiction for approval of the form and content of the documentation.

Z1020 QUALITY REQUIREMENTS (PROGRAMMATIC & FACILITY)

- A. Projects shall comply with LANL-applicable QA requirements documents. *These may include:*
- [DOE O 414.1A, Quality Assurance](#)
 - [DOE G 414.1-2, Quality Assurance Management System Guide for use with 10 CFR 830.120 and DOE O 414.1](#)
 - *LANL LPR 308-00-00, Institutional Quality Management*
 - *LANL LIR 308-00-04, Procurement Quality*
 - *LANL LIR 308-00-05, Software Quality Management*

- *Additional requirements in other ESM chapters*
 - *Division or project-specific QA requirements*
- B. For nuclear safety-related projects, see ESM Chapter 12--Nuclear, Quality Assurance Subsection, for additional requirements (*including 10CFR830*).

Z1030 TEMPORARY FACILITIES

- A. For buildings, additions, transportables, trailers, and similar structures, **permanent** is defined as intended to be in place for 3 years or longer (“substantial and permanent” refers to also having an initial total project cost of greater than \$100,000); **temporary** is defined as less than 3 years.
- B. Temporary facilities are **not** required to meet ESM requirements that reduce the life-cycle cost of permanent facilities. Temporary facilities **are** required to meet all DOE contractual requirements as well as all ESM requirements for security and safety/health of occupants, the public, and the environmental.
- C. The FWO Chief Engineer has the authority to interpret and grant variance to this section (Z1030) and related requirements in other ESM chapters. *Guidance: The requestor may be asked to submit life-cycle analysis.*
- D. *Guidance: For subcontracted construction work, the Contract may contain requirements for the Contractor regarding temporary facilities to support construction (e.g., offices, restrooms).*

Z1040 PROJECT CLOSEOUT

- A. At the completion of facility projects, transmit drawings, specifications, and other project records to FWO in accordance with LANL Construction Specifications Section 01720, Project Record Documents (or project-specific spec section with equivalent or superior requirements). *For projects subject to review beyond the FM, this should be done as a project submittal through the FWO technical review process. When the project is not subject to such review, send directly to FWO-IBS Document Control & Records Management (DCRM), M703, at TA-3-410 (becoming TA-63-121).*
1. Records shall be sent to satellite records centers only when FWO’s DCRM team has agreed to such arrangements in writing.
- B. For drawings, follow additional requirements for transmittal in the LANL Drafting Manual.

APPENDICES

APP A: SUSTAINABLE DESIGN REQUIREMENTS (FACILITY ONLY)